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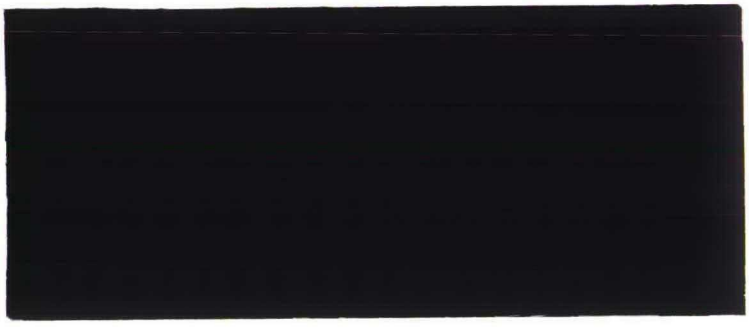

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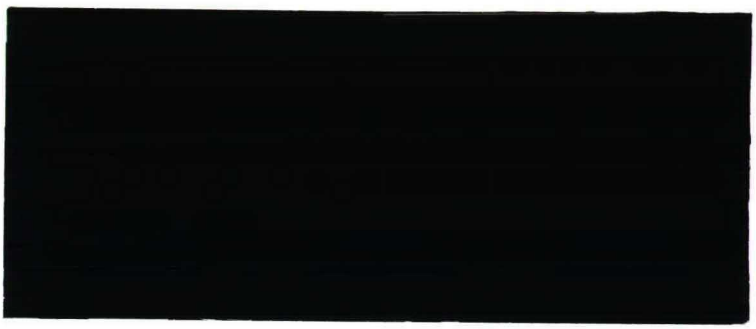

# ON THE EFFECTIVENESS OF DAILY INTERVENTIONS BY THE DEUTSCHE BUNDESBANK AND THE FEDERAL RESERVE SYSTEM IN THE U.S. DOLLAR - DEUTSCHE MARK EXCHANGE MARKET

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# ON THE EFFECTIVENESS OF DAILY INTERVENTIONS BY THE DEUTSCHE BUNDESBANK AND THE FEDERAL RESERVE SYSTEM IN THE U.S. DOLLAR-DEUTSCHE MARK EXCHANGE MARKET

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## 1. INTRODUCTION

The purpose of this paper is to test empirically whether interventions by the Deutsche Bundesbank and the Federal Reserve System in the U.S. dollar-Deutsche Mark spot exchange market were effective during the period from February 1985 up to August 1988.
After a short description of some aspects of official interventions in foreign exchange markets and a description of three mechanisms through which intervention can influence the exchange rate in theory (section 2), an empirical study is carried out with daily data on interventions by the Bundesbank and the Federal Reserve (section 3). With these daily data it is possible to test whether interventions had an immediate impact on the dollar-DM exchange rate by altering the market expectations, whether coordinated interventions were more effective than non-coordinated interventions and whether the effectiveness of interventions was determined by their announcement effect.

## 2. SOME ASPECTS OF OFFICIAL INTERVENTION

### 2.1. Definition

Since the breakdown of the Bretton Woods fixed exchange rate system in the early seventies, the exchange value of the major currencies in the industrialized world (for instance the U.S. dollar-the Deutsche Mark and the Japanese yen) is in principle determined by market forces. However, in the present system of managed floating the exchange rate is not the outcome of supply and demand by market participants only. The monetary authorities of many countries have tried to influence the relative value of their currencies frequently by exchange market interventions.

An official intervention is a sale or purchase of foreign exchange against domestic currency, which monetary authorities undertake in the exchange market[1]. According to the Report of the Working Group on exchange market intervention (1983), interventions in the past have served as a means for different kinds of objectives, related to both short term and long term market conditions.

In the short run monetary authorities intervened to 'counter disorderly market conditions', as indicated by a widening of bid-offer spreads, increasing uncertainty in the market or large intra day exchange rate movements. Under such circumstances official interventions were used to influence market psychology and to resist exchange rate movements that gain a momentum of their own (so called 'bandwagon'-effects). Monetary authorities intervened over longer periods to smooth exchange rate movements and to bring the exchange rate in line with an equilibrium value based on 'fundamentals' (for example inflation, money growth and balance of payment accounts).

Beside these 'active' interventions to influence the exchange rate directly, central banks at times intervened on other motives such as to build up foreign exchange reserves or to carry out customer transactions[2]. These customer transactions are purchases or sales of foreign currency undertaken by a central bank on behalf of for example its government. Although their ultimate objectives differ, the effect of these 'passive' interventions and the 'active' interventions on the exchange rate may be the same in practice, if the customer transactions are guided by exchange policy considerations and if these transactions are timed properly[3].

The monetary authorities can intervene in either the spot market or the forward market. A purchase or sale of foreign currency in the forward market will be preferred, if the monetary authorities want to postpone the

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1) This definition is taken from the Report of the Working Group on exchange Market Intervention, under the direction of Ph. Jurgensen, March 1983, p. 4. The Working Group was established at the G7 Summit in Versailles, June 1982, to carry out an international study of experience with intervention among these countries.

2) See the Report of the Working Group (1983), p. 4.

3) In reality, this is the case for the central bank of West-Germany, the Deutsche Bundesbank. See Gleske (1982) p. 269 and Scholl (1983), p. 121.

effects of an intervention on the domestic monetary base or money supply. However, an intervention in the forward market will only affect the current spot exchange rate if the opponent of the central bank in the forward market transaction immediately offsets the exchange risk on the uncovered forward position in the spot market[4].

Finally, a distinction can be made between sterilized and non-sterilized interventions. Sterilized intervention refers to purchases and sales of foreign currency whose impact on the home country's money stock is offset through domestic open-market transactions[5]. If, for instance, the central bank purchases foreign exchange against domestic currency from commercial banks in order to support the value of foreign currency, the reserve position of the banking sector as a whole increases. As soon as the commercial banks supply more credit facilities to the public based upon their increased liquidity position, the exchange market intervention results in an increase of the domestic money supply. If such an increase is not consistent with the central bank's monetary growth objective, the central bank can sterilize the liquidity effect of the intervention by selling domestic currency assets to the banking sector, leaving the monetary base unchanged.

If sterilized interventions have a permanent effect, the monetary authorities are able to realize an exchange rate target independent of a monetary growth target. If, on the other hand, sterilized interventions are not effective and non-sterilized (or: partially sterilized) interventions do affect the exchange rate, the effectiveness of interventions depends primarily on the influence of a change in the money supply on the exchange rate. In theory both sterilized and non-sterilized interventions may have a permanent influence on the relative value of a currency through different transmission mechanisms.

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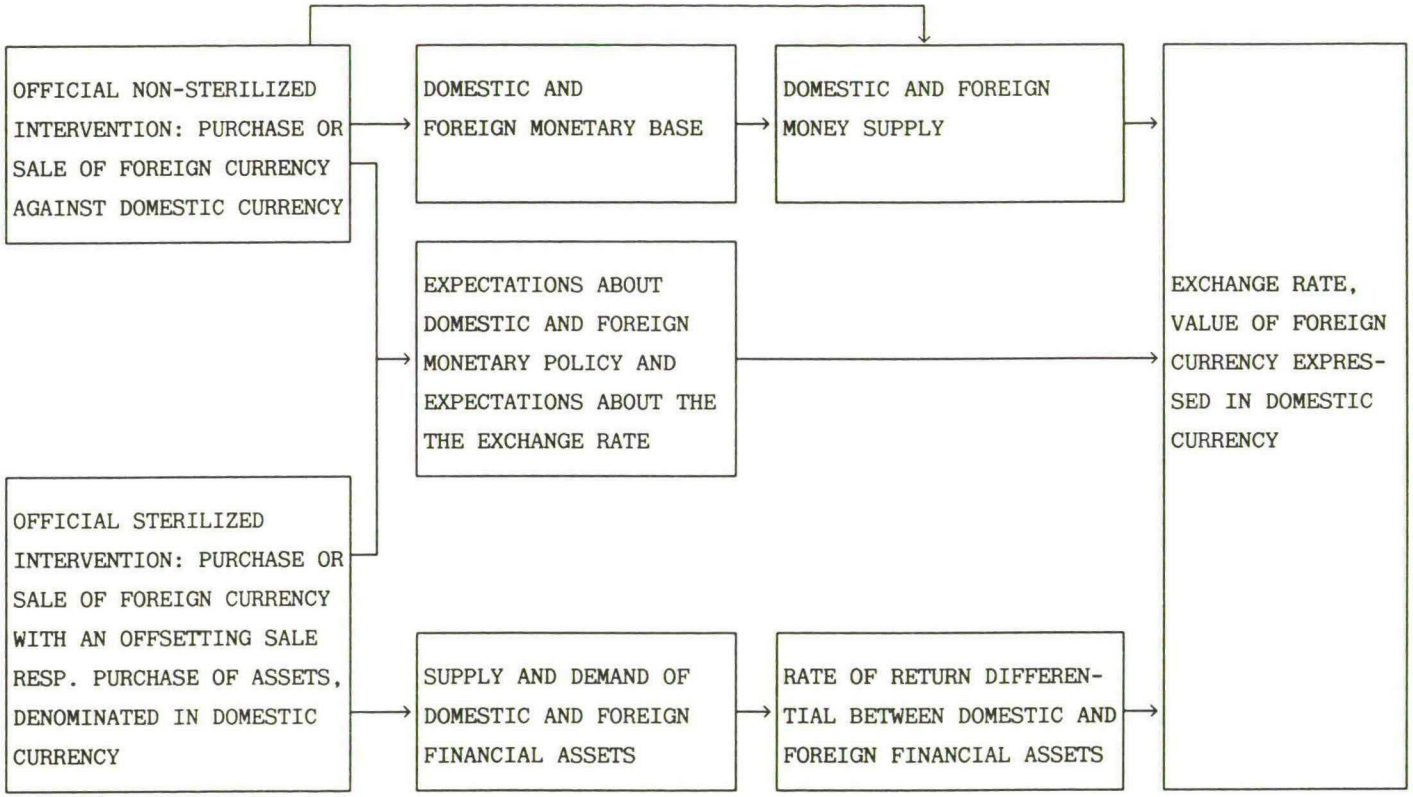
4) As far as the central bank deals with a commercial bank in the forward market, this condition is met because commercial banks are not allowed by regulation to hold large uncovered positions in exchange markets. See Gleske (1982), p. 266 and Scholl (1983), p. 121.

5) The definition is quoted from Humpage (1986), p. 2.

FIGURE 1. THREE CHANNELS OF INFLUENCE OF OFFICIAL INTERVENTION



## 2.2. Three channels of influence[6)]

Humpage (1986) mentions three different channels through which exchange market intervention can influence exchange rates: the monetary channel, the portfolio-adjustment channel and the expectations channel (See figure 1):

1. In the monetary channel an intervention influences the exchange rate if the effect of the intervention on the relative money supply of both countries is not completely sterilized. Under this condition a purchase of foreign exchange by the monetary authorities will result in an increase of the domestic money supply. According to the classical quantity theory of money, an increase of the money supply will result in a similar increase of the domestic price level. If the exchange rate is determined by trade flows and purchasing power parity, the domestic currency will depreciate as a consequence of the rise in the domestic price level. Although this adjustment process takes time and although purchasing power parity may not hold, the relative rates of money growth between different countries are important determinants of nominal exchange rates and therefore, non-sterilized interventions may be effective in the long run. Moreover, an intervention may be effective through the monetary channel in the short run, under the assumption of rational expectations. If, for instance, a purchase of foreign currency by the domestic central bank is interpreted by the market as a sign of a future expansionary monetary policy, the domestic currency will depreciate immediately[7)].

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6) This section is based on the more extensive discussion on channels of influence for interventions by Humpage (1986). Genberg (1981), Loopeskoo (1984) and Müller (1984) also discuss transmission mechanisms of interventions by monetary authorities.

7) See Genberg (1981), p. 454. However it is very risky for the monetary authorities to count on this expectations effect of an intervention because this purchase of foreign currency could also be interpreted as a temporary easing of monetary conditions and hence could generate expectations of future monetary contraction. In the last case the intervention would result in an undesired appreciation of the domestic currency.

2. A sterilized intervention can be effective through the portfolio-adjustment channel under the two assumptions that (1) the public holds both domestic and foreign financial assets in their portfolios and that (2) these assets are not perfect substitutes. In this situation investors will not be indifferent about the currency denomination of the securities in their portfolios, because of for instance differences in exchange rate risk, political risk and default risk between domestic and foreign assets. In order to induce the risk-averse investors to hold the supply of domestic and foreign assets, equilibrium in the financial markets results in a risk premium on the more risky (foreign) assets. This risk premium equals the nominal interest differential between foreign and domestic assets plus the expected rate of depreciation of the domestic currency against the foreign currency.

A sterilized intervention can influence the exchange rate by changing the relative supply of domestic and foreign assets. Suppose that the monetary authorities sterilize the expansionary effect of a purchase of foreign currency on the domestic money supply by an offsetting sale of domestic securities. This sterilized intervention results in an excess supply of domestic securities and, in order to rebalance their portfolios, an excess demand of foreign securities by the investors. Given the supply of foreign assets, the foreign interest rate and the expected future spot rate, financial market equilibrium will be restored by a rise in the domestic interest rate and a depreciation of the domestic currency (a rise in the current spot rate) both leading to a drop in the risk premium on foreign assets. Thus, in theory monetary authorities can do both realising a monetary growth objective and an exchange rate objective by sterilizing interventions. In practice, the empirical evidence on the effectiveness of sterilized intervention is weak[8] and monetary policy makers themselves have expressed their doubts on the possibility to exert a significant effect

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8) See for example Rogoff (1981) and Loopeskoo (1984).

on exchange rates in the face of persistent market pressures by sterilized intervention[9]. Furthermore, in reality the distinction between sterilized and non-sterilized intervention becomes fuzzy in the short run, as central banks do not automatically compensate an intervention by an offsetting open market operation[10].

3. Finally, monetary authorities can try to influence the exchange rate through the expectations channel.
If foreign exchange markets were perfectly efficient, all the relevant information on exchange rate determinants would be aggregated, correctly interpreted and finally processed by the market participants into a rational expectation for the future spot rate. If no market imperfections such as transaction costs and capital restrictions existed, the current spot rate would be consistent with this expectation for the future spot rate at any moment because of the positions taken by profit-maximizing speculators and arbitragers in the market. In such a world central banks would not be able to influence the exchange rate through interventions, without changing their monetary policies, but, on the other hand, there would be no need for interventions. Nevertheless, in the real world of uncertainty, excessive exchange rate movements, 'bandwagon'-effects, speculative bubbles and market imperfections, there is a case for official intervention. As soon as the market does not take account of all the relevant information of 'fundamentals' or of changes in these exchange rate determinants, central banks can try to give the market a signal by an intervention. This supposes, however, that the monetary authorities have a better insight in economic developments or possess better information than the market. But if the monetary authorities are able to emphasize neglected information or to provide new information by intervening, the exchange rate will be

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9) See the Report of the Working Group (1983), p. 20. According to the Working Group an intervention is more effective if it is accompanied by domestic policy adjustments. By sterilizing an intervention however the domestic monetary policy remains unchanged.

10) See Schlesinger (1984), p. 81.

affected immediately in a highly (although not perfectly) efficient market.

Thus, it is possible that interventions, whether sterilized or non-sterilized, affect the exchange rate through the expectations channel. Although it can be very difficult to change market expectations, the monetary authorities have intervened frequently on a large scale to remove perceived market inefficiencies[11]. The effectiveness of these interventions will, however, depend on the specific circumstances, the timing and scale of the intervention, the opinion and determination of the market as well as on the credibility of the monetary authorities[12].

## 3. INTERVENTIONS BY THE DEUTSCHE BUNDESBANK AND THE FEDERAL RESERVE SYSTEM IN THE DOLLAR-DM MARKET

### 3.1. Specification of the regression equations

In this section an empirical study is undertaken, with daily intervention data and intraday exchange rate data, into the question whether the Deutsche Bundesbank and the Federal Reserve System have been able to influence the dollar-DM exchange rate systematically through the expectations channel from February 1985 up to August 1988. Although the effectiveness of interventions depends (as is mentioned above) on the specific circumstances at the moment of the intervention, it makes sense to test for the systematical effectiveness of interventions, under the assumption that the Bundesbank and the Federal Reserve will only intervene when the circumstances are favorable to attain their exchange rate objective in the short run.

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11) See the Report of the Working Group (1983), p. 21: 'The authorities in each of the Summit countries at times undertook large-scale intervention when they judged that market participants had not taken full account of fundamental factors...'.

12) See Mayer & Taguchi (1983), p. 8.

This empirical analysis is limited to the spot interventions of the Bundesbank and the Federal Reserve in the U.S. dollar-DM market[13].

Officially, both the Bundesbank and the Federal Reserve intervene in the first place to 'counter disorderly market conditions'. However, the criterium of 'disorderly market conditions' is open to discussion and therefore compatible with different strategies for intervention. For example, if disorder is associated with erratic short term exchange rate fluctuations a policy of 'leaning against the wind' would seem to be appropriate for intervention. A 'leaning against the wind' policy is oriented towards the actual path of the exchange rate. As soon as the current exchange rate rises or falls the central bank will sell respectively purchase foreign exchange in order to smooth excessive exchange rate swings in both directions.

If, on the contrary, disorder is associated with an under- or overvaluation of a currency regarding 'fundamentals', the intervention policy will be oriented towards an equilibrium value of the exchange rate. In this case a central bank will sell or purchase foreign currency as long as it is believed to be over- respectively undervalued.

Ex-post it can be inferred from the change in the foreign currency reserves of a central bank during a long period, which policy is followed. If a 'leaning-against the wind' policy is carried out the central bank reserves will not have changed remarkably: the sales of foreign currency will in general equal the purchases. If, however, a central bank has tried to guide the exchange rate to an equilibrium level by interventions, the foreign currency reserves will change in one direction through either sales or purchases of foreign exchange[14].

The daily data on interventions of the Bundesbank and the Federal Reserve in the dollar-DM exchange market during February 1985 until September 1988 show that interventions were concentrated in specific months and thus that periods of intervention were alternated by longer periods of non-intervention. Moreover, the interventions in these relatively short periods were

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13) The Bundesbank does not undertake dollar interventions within the EMS. See Scholl (1982), p. 121. For an empirical analysis of interventions within the EMS, see Eijffinger (1988).

14) See Lehment (1980), p. 140.

one-sided (either purchases or sales) with the exceptions of September 1986 and August 1987. In these two months the Bundesbank first sold dollars and later purchased dollars. Thus, it may be concluded that neither the Bundesbank (although intervening more frequently and for larger amounts), nor the Federal Reserve intervened only to smooth exchange rate movements, but also tried to influence the exchange rate (or market sentiment) in a specific direction towards an equilibrium value[15].

Therefore, whatever the ultimate objective and the precise strategy followed by the Bundesbank and the Federal Reserve may be, interventions are considered to be effective in this study as soon as a purchase (sale) of dollars results in (1) a rise (fall) of the dollar-DM exchange rate, or in (2) a deceleration of a downward (upward) movement in the exchange rate. In the first case the central banks reverse the exchange rate movement and in the second case they slow down the exchange rate movement by intervening.

Under the assumption of highly efficient markets, effective interventions will influence the exchange rate movement immediately (i.e. within the same day) by altering the expectations of market participants. Thus, the intraday change of the dollar-DM exchange rate can be written as a function of (inter alia) interventions by the Bundesbank and the Federal Reserve:

$$S_t^u - S_t^p = f[\Delta(i^{DM}-i^{\$})_t, \underset{(-)}{INV_t^{DBB}}, \underset{(+)}{INV_t^{FED}}] \qquad (1)$$

with: $S_t^u$ = the dollar-DM closing rate (ultimo) in Frankfurt on day t defined as the DM price of one dollar.

$S_t^p$ = the dollar-DM opening rate (primo) in Frankfurt on the same day t.

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15) As an example reference can be made to the weeks immediately after the G5 Plaza Agreement of 22 September 1985. Although the dollar falling almost without interruption from 26 February 1985 the Bundesbank and the Federal Reserve sold dollars, because they meant that the dollar was overvalued and did not reflect changes in economic conditions. See Cross (Winter 1985-1986), p. 46.

$\Delta(i_t^{DM}-i_t^{\$})$ = the change in the interest differential between one-month Euro-DM - and Eurodollar deposits in London during day t.

$INV_t^{DBB}$ = spot market interventions by the Bundesbank during day t defined as purchases of dollars expressed in billions of DM.

$INV_t^{FED}$ = spot market interventions by the Federal Reserve during day t defined as purchases of dollars expressed in billions of DM[16].

Assuming that trade flows adjust slowly and other 'fundamentals' do not change in short term, the intraday exchange rate movement is explained primarily by short term capital flows. Supposing that investors balance their portfolios at every moment, a change in the interest rate differential will cause imbalances and thus immediately induce an adjustment process in the highly efficient financial markets. A relative rise in the DM interest rate will bring about a demand surplus for DM assets. Given the supply of DM assets in the short run, portfolio equilibrium will be restored by a fall in the exchange rate (i.e. an appreciation of DM and a depreciation of dollar). If the Bundesbank and the Federal Reserve are able to influence the marketsentiment, the exchange rate will rise after the news of dollarpurchases by the central banks.
Reasoning along the same lines, a smoothing of the exchange rate movements by interventions of the Bundesbank and the Federal Reserve can be formalized as follows:

$$(S_t^u-S_t^p) - (S_t^p-S_{t-1}^u) = f[\Delta(i^{DM}-i^{\$})_t^{(-)}, INV_t^{DBB(+)}, INV_t^{FED(+)}] \qquad (2)$$

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16) For a description of the data see the appendix.

By purchasing dollars during the day the central banks may try to retard a depreciation of the dollar, started during the preceding night $((S^{p}_{t}-S^{u}_{t-1}) < (S^{u}_{t}-S^{p}_{t}) < 0)$[17].

In order to capture both elements of effective interventions, reversing and slowing down exchange rate movements, the empirically estimated equation is chosen to be of an unrestricted form:

$$S^{u}_{t} = a_0 + a_1 S^{p}_{t} + a_2 S^{u}_{t-1} + a_3 \Delta(i^{DM}-i^{\$})_t + a_4 INV^{DBB}_{t} + a_5 INV^{FED}_{t} \qquad (3)$$

$\qquad\qquad (+) \qquad (-) \qquad\qquad (-) \qquad\qquad (+) \qquad\qquad (+)$

According to the discussion above, the estimates are expected to yield positive values for the opening rate coefficient ($a_1$) and the intervention coefficients ($a_4$, $a_5$) and negative values for the lagged closing rate coefficient ($a_2$) and the interest coefficient ($a_3$). Because the effectiveness of interventions does not only depend on the volume of dollar purchases or sales[18], but also on other circumstances, the empirical analysis is extended with two other equations.

In the first place it is generally supposed that coordinated interventions of both central banks are more effective than non-coordinated interventions by either the Bundesbank or the Federal Reserve[19]. The reason for a difference in their effectiveness is that coordinated interventions are

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17) By chosing the U.S. dollar-DM opening and closing rates in Frankfurt, a 24-hour day can be divided in two segments: the European segment (the day) and the non-European segment (the night). The assumption has been made that Federal Reserve interventions in the dollar-DM market take place during the European segment of the day.

18) See Scholl (1983), p. 121: 'In some situations even small intervention amounts may suffice to slow down or even reverse an undesirable exchange rate movement. In other situations even large intervention amounts may have the opposite effect ...'.

19) See for instance Ohr (1985), p. 211 and the Report of the Working Group (1983), p. 26: 'closely coordinated action had at times been more effective than intervention by only one central bank'. Loopeskoo (1984), p. 268-270 finds some empirical evidence that active coordinated German-U.S. intervention had a <u>different</u> impact on exchange rates than non-coordinated interventions, but she cannot confirm whether coordinated interventions had a stronger impact than non-coordinated interventions.

interpreted by the market as a strong signal that both monetary authorities have adopted the same exchange rate objective and are determined to reach this objective even by adjusting their policies.

If the Bundesbank and the Federal Reserve intervene on the same day, these interventions are closely coordinated by a concertation procedure. The daily data can therefore be divided in three non-overlapping categories: coordinated interventions by both central banks ($CINV_t$), non-coordinated interventions by the Bundesbank ($NCINV_t^{DBB}$) and non-coordinated intervention by the Federal Reserve ($NCINV_t^{FED}$). The resulting regression equation can be written as:

$$S_t^u = a_0 + \underset{(+)}{a_1 S_t^p} + \underset{(-)}{a_2 S_{t-1}^u} + \underset{(-)}{a_3 \Delta(i^{DM}-i^{\$})_t} + \underset{(+)}{a_4 CINV_t} + \underset{(+)}{a_5 NCINV_t^{DBB}} + \underset{(+)}{a_6 NCINV_t^{FED}} \qquad (4)$$

If the hypothesis that coordinated interventions are more effective is correct, the coordination coefficient ($a_4$) will come out positive and more significant than the non-coordination coefficients ($a_5$, $a_6$).

The second adaptation of the original regression equation (3) is based on Humpage (1988). In an highly efficient market the effectiveness of an intervention through the expectations channel depends primarily on the information content of the intervention for the market participants. Humpage (1988) distinguishes 'initial' and 'subsequent' interventions. An initial intervention is defined as an official transaction after a period of a few days without interventions. Humpage (1988) argues that the announcement effect and thus the news content of initial interventions is larger than the news content of the subsequent interventions, falling within a few days after the initial interventions. Thus, the effectiveness

of initial interventions is expected to be higher than the effectiveness of subsequent interventions[20].

If initial interventions are defined arbitrarily as an official transaction after three business days without interventions[21], the daily intervention data can be split up into initial and subsequent interventions by the Bundesbank ($IINV_t^{DBB}$ respectively $SINV_t^{DBB}$) and initial and subsequent interventions by the Federal Reserve ($IINV_t^{FED}$ respectively $SINV_t^{FED}$):

$$S_t^u = a_0 + a_1 S_t^p + a_2 S_{t-1}^u + a_3 \Delta(i^{DM}-i^{\$})_t + a_4 IINV_t^{DBB} + a_5 SINV_t^{DBB} + a_6 IINV_t^{FED} + a_7 SINV_t^{FED} \qquad (5)$$

(+) (-) (-) (+) (+) (+) (+)

If initial interventions are more effective than subsequent interventions through their announcement effect, the initial coefficients ($a_4$, $a_6$) will be positive and more significant than the subsequent coefficients ($a_5$, $a_7$).

## 3.2. Empirical Results

The regression equations are estimated, due to the availability of intraday data for the dollar-DM exchange rate for the period February 1985 up to August 1988. During this period the dollar fell with interruptions from

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20) Humpage (1988) tests this hypothesis for three short periods of intervention by the Federal Reserve. The results are mixed and he concludes inter alia that intervention can have a temporary announcement effect, but this effect is not universal in all periods and is short-lived.

21) Humpage's investigation (1988) differs from this study in some respects: (1) he does not dispose of the amounts of official interventions but constructs dummy variables for Federal Reserve interventions, (2) he does not include interventions by the Bundesbank in the dollar-DM market, (3) he chooses relatively short periods and defines initial interventions as official transactions after five business days with no intervention. In order to dispose of more observations for initial interventions, we have chosen longer periods and defined initial intervention as official transactions after three business days with no intervention.

TABLE 1. THE EFFECTIVENESS OF OFFICIAL INTERVENTIONS IN THE DOLLAR-DM EXCHANGE MARKET

| Equation (OLS) | $S_t^u = a_0 + a_1 S_t^p + a_2 S_{t-1}^u + a_3 \Delta(i^{DM} - i^{\$})_t + a_4 INV_t^{DBB} + a_5 INV_t^{FED}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Period | $a_0$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $R^2$ | $\bar{R}^2$ | DW | LM |
| Febr.-June 1985 | -0,0063 (-0,089) | 0,9037 * (8,650) | 0,0988 (0,948) | -2,0196 (-0,678) | 0,0196 * (2,741) | -0,0606 (-1,188) | 0,9610 | 0,9589 | 2,0786 | 0,2560 |
| July-Dec. 1985 | 0,0234 (0,928) | 1,0812 * (13,378) | -0,0901 (-1,120) | -1,1928 (-0,841) | 0,0079 (0,398) | — | 0,9901 | 0,9897 | 2,1570 | 0,8232 |
| Jan.-June 1986 | 0,0472 (1,573) | 1,0189 * (14,279) | -0,0400 (-0,560) | -1,5660 (-1,286) | 0,0769 (1,278) | — | 0,9806 | 0,9799 | 1,8404 | 0,8099 |
| July-Dec. 1986 | 0,0030 (0,108) | 0,9340 * (11,244) | 0,0639 (0,782) | 0,1061 (0,164) | 0,0022 (0,385) | — | 0,9778 | 0,9770 | 1,8286 | 0,8570 |
| Jan.-June 1987 | 0,2308* (3,724) | 1,0101 * (13,381) | -0,1327 * (-1,702) | 0,2672 (1,462) | -0,0057 (-0,556) | 0,0142 (0,636) | 0,9302 | 0,9271 | 1,7659 | 1,6013 |
| July-Dec. 1987 | 0,0281* (2,277) | 1,0433 * (14,681) | -0,0591 (-0,823) | 0,6620* (2,335) | -0,0090 (-1,390) | -0,0077 (-1,443) | 0,9952 | 0,9950 | 2,2274 | 1,7333 |
| Jan.-June 1988 | 0,0520 (1,177) | 0,8605 * (7,522) | 0,1096 (0,901) | 0,6745 (0,839) | -0,0135 (-1,507) | 0,0196 (1,543) | 0,9585 | 0,9567 | 1,7928 | 0,5869 |
| July-Aug. 1988 | 0,2449* (2,364) | 1,1519 * (6,910) | -0,2821 (-1,607) | -0,7297 (-0,531) | -0,0004 (-0,065) | 0,0062 (0,918) | 0,9024 | 0,8892 | 2,2392 | 1,0305 |

Note: t-values within brackets
* = statistically significant at a 5% level
$\bar{R}^2$ = squared multiple correlation coefficient, adjusted for degrees of freedom
LM = Lagrange multiplier test of residual serial correlation; critical value test statistic $x^2(1) = 3,84$ ($\alpha = 0,05$)

its maximum level of DM 3,4720 on 26 February 1985 to its minimum level of DM 1,5785 on 31 December 1987 and recovered later to DM 1,8792 on 31 August 1988. These exchange rate movements indicate many important developments during these years, for instance the growing instability of financial markets, the persistent balance of payments disequilibria between the United States, Japan and Europe, a changing attitude of the U.S. government from 'benign neglect' towards a more 'active' exchange rate policy and the first efforts for international coordination of fiscal and monetary policies among the major industrialized countries[22]. As a consequence of the use of daily data, the regressions cannot possibly include these more fundamental developments, because of their stickiness on a daily base. Instead the estimates are performed for eight subperiods of in principle six months[23], under the assumption that changes in fundamentals proceed slowly and not within a few days[24]. Therefore, the influence of 'fundamentals' may be reflected in a positive or negative constant ($a_0$).

Table 1 gives the results for the first regression equation (3), including the amounts of intervention by the Bundesbank and the Federal Reserve.
As can be seen in the table the constant ($a_0$) is positive and significant in three periods. The opening rate coefficient ($a_1$) is in all cases significantly positive and close to one, as expected. On the contrary, the lagged closing rate does not contribute significantly to the explanation of the current closing rate in seven cases. In addition, the four positive (of which one significant) values for the interest rate coefficient ($a_3$) are a rather counterintuitive results; apparently capital flows are influenced by other factors and cannot be captured by a change in the short term interest differential between both countries on a daily base.

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22) For a discussion of the origins, the historical background and possible solutions for these worldwide imbalances, see Sijben (1989).

23) With the exception of the first subperiod of five months and the last subperiod of two months; See appendix.

24) Besides the purpose of this article is not as much to explain the exchange rate developments as well to test whether official interventions had an immediate impact on the exchange rate.

The results on the effectiveness of intervention by the Bundesbank and the Federal Reserve in table 1 are somewhat disappointing. Only in the first half of 1985 the intervention coefficient ($a_4$) is significantly positive and thus the interventions of the Bundesbank were effective. By selling dollars in sometimes very large amounts during February and the beginning of March the Bundesbank was able to cause a sharp decline in the value of the dollar. As soon as a more negative marketsentiment towards the dollar was established in March 1985 as a result of troubles in the Ohio thrift industry and of the slowing U.S. economic growth, the Bundesbank and the Federal Reserve did not intervene despite considerable uncertainty in the dollar-DM exchange market, reflected by sharp daily exchange rate movements and wider bid-offer spreads. Nor did they intervene when the dollar firmed late in April and was traded relatively steadily through the end of June[25].

According to our data, the Federal Reserve did not actively intervene in the dollar-DM market from the second half of 1985 until the first half of 1987. There is some evidence for effective interventions by the Bundesbank in the first half of 1986 and by the Federal Reserve in the first half of 1988. However, in the last four periods the intervention coefficients, although not significantly different from zero, have sometimes a negative sign suggesting that interventions may have been counterproductive. In these four periods the Bundesbank and the Federal Reserve both purchased dollars (especially during the last three months of 1987, after the stock market crash of October 1987) and sold dollars (especially during June, July and August 1988) in order to stabilize the dollar after the Louvre agreement of 22 February 1987[26]. Despite frequent reaffirmations of their commitment to exchange rate stability and despite frequent interventions, both central banks do not appear to have been able to counter the downward pressure on the dollar in the last months of 1987 and the upward pressure

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25) See Cross (Summer, 1985), p. 59 and Cross (Autumn, 1985), p. 53.

26) On 22 February 1987 the monetary authorities of the G7 countries (except Italy) agreed on closer cooperation to foster stability of exchange rates around the levels at the time of the Louvre Summit. See Funabashi (1988), p. 181-182.

on the dollar in the summer of 1988. An explanation for the ineffectiveness of the interventions in these periods may be that the exchange rate path implied by the official interventions was the opposite of the market expectations on the future course of the exchange rate, based on the market interpretation of changing 'fundamentals' and on perceived policy changes[27].

The frequently changing market sentiment in these last four periods indicates a high degree of uncertainty among the market participants. In such an environment public statements by policy makers and the announcement of specific economic indicators (for instance the monthly announcements of the U.S. trade balance- and the U.S. economic growth-figures) can cause sharp exchange rate movements. Because these extreme exchange rate fluctuations could influence the estimation results, the regression equation (3) is extended with dummy-variables ($TD_1$ to $TD_6$) for the monthly announcements of the U.S. trade balance-figure:

$$s_t^u = a_0 + a_1 S_t^p + a_2 S_{t-1}^u + a_3 \Delta(i^{DM}-i^{\$})_t + a_4 INV_t^{DBB} + a_5 INV_t^{FED} \qquad \begin{matrix} (+) & (-) & (-) & (+) & (+) \end{matrix}$$

$$+ b_1 TD_1 + b_2 TD_2 + b_3 TD_3 + b_4 TD_4 + b_5 TD_5 + b_6 TD_6 \qquad (6)$$

The signs of the trade dummy coefficients ($b_1$ to $b_6$) will depend on the news content of the announcements: if the U.S. trade deficit is smaller or

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27) The bearish market sentiment after the stock market crash was caused by doubts in the markets whether the monetary authorities of the G7 countries would maintain exchange rate stability and international coordination as important policy objectives, by disappointing outcomes of the U.S. budget reduction negotiations and by pessimistic growth perspectives after the crash. See Cross (Winter 1987-'88), p. 54-56. The bullish marketsentiment on the dollar during the summer of 1988 was a result of the buoyant U.S. economic growth, market expectations of a tighter US monetary policy and the announcement of a much smaller-than-expected US trade deficit in June and July. See Cross (Summer 1988).

TABLE 2. THE EFFECTIVENESS OF OFFICIAL INTERVENTION IN THE DOLLAR-DM EXCHANGE MARKET, ADJUSTED FOR EXCHANGE RATE SHOCKS AFTER NEWS ON THE U.S. TRADE BALANCE

| Equation (OLS) | $S^u_t = a_0 + a_1 S^p_t + a_2 S^u_{t-1} + a_3 \Delta(i^{DM} - i^{\$})_t + a_4 INV^{DBB}_t + a_5 INV^{FED}_t + b_1 TD_1 + b_2 TD_2 + b_3 TD_3 + b_4 TD_4 + b_5 TD_5 + b_6 TD_6$ | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | $a_0$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | $R^2$ | $\bar{R}^2$ | DW | LM |
| Febr.-June 1985 | -0,0069 (-0,097) | 0,8753 * (8,393) | 0,1278 (1,222) | -2,8200 (-0,941) | 0,0201 * (2,855) | -0,0552 (-1,096) | -0,0542 * (-2,041) | -0,0133 (-0,517) | 0,0198 (0,765) | -0,0181 (-0,700) | -0,0328 (-1,272) | -0,0306 (-1,185) | 0,9645 | 0,9600 | 2,0417 | 0,0587 |
| July-Dec. 1985 | 0,0272 (1,039) | 1,1169 * (12,981) | -01272 (-1,481) | -1,143 (-0,777) | 0,0078 (0,382) | — | 0,0193 (1,184) | 0,0071 (0,453) | -0,0118 (0,746) | -0,0147 (-0,939) | 0,0138 (0,009) | 0,0046 (0,290) | 0,9903 | 0,9895 | 2.1616 | 0,8686 |
| Jan.-June 1986 | 0,0502 (1,597) | 1,0138 * (13,529) | -0,0361 (-0,481) | -1,4200 (-1,123) | 0,0746 (1,212) | — | -0,0105 (-0,798) | -0,0038 (-0,290) | 0,0029 (0,222) | -0,0101 (-0,766) | 0,0111 (0,832) | -0,0062 (-0,475) | 0,9810 | 0,9791 | 1,8365 | 0,8705 |
| July-Dec. 1986 | -0,0011 (-0,039) | 0,9704 * (12,028) | 0,0295 (0,373) | 0,2918 (0,446) | 0,0023 (0,418) | — | -0,0062 (-0,720) | -0,0193 * (-2,193) | 0,0023 (0,268) | 0,0276* (3,186) | 0,0018 (0,203) | -0,0072 (-0,802) | 0,9805 | 0,9788 | 1,8955 | 0,3053 |
| Jan.-June 1987 | 0,1437* (3,769) | 0,9672 * (13,736) | -0,0461 (-0,645) | 1,6300* (2,325) | -0,0015 (-0,174) | 0,0015 (0,777) | 0,0462* (6,301) | 0,0024 (0,332) | — | 0,0035 (0,458) | -0,0105 (-1,433) | 0,0089 (1,206) | 0,9513 | 0,9468 | 1,6187 | 4,2338 |
| July-Dec. 1987 | 0,0199* (1,824) | 1,0584 * (17,627) | -0,0694 (-1,141) | 0,6134* (2,500) | -0,0076 (-1,402) | -0,0060 (-1,328) | -0,0195 * (-3,719) | -0,0189 * (-3,583) | -0,0067 (-1,256) | -0,0123 * (-2,350) | 0,0126* (2,389) | -0,0220 * (-4,169) | 0,9968 | 0,9965 | 2,0742 | 0,2141 |
| Jan.-June 1988 | -0,0058 (-0,179) | 0,9106 * (10,931) | 0,0935 (1,058) | 0,7556 (1,303) | 0,0019 (0,281) | 0,0179* (1,944) | 0,0455* (8,036) | 0,0152* (2,708) | 0,0081 (1,450) | -0,0272 * (-4,647) | 0,0144* (2,580) | 0,0217* (3,842) | 0,9797 | 0,9776 | 1,4834 | 4,1347 |
| July-Aug. 1988 | 0,2096* (2,192) | 1,1328 * (7,402) | -0,2438 (-1,510) | -0,7736 (-0,607) | 0,0017 (0,330) | 0,0071 (1,130) | 0,0205* (2,412) | -0,0152 * (-1,787) | — | — | — | — | 0,9225 | 0,9070 | 1,9875 | 0,0063 |

Note: See Table 1. t-values within brackets
* = statistically significant at 5% level (one-sided test).

TABLE 3. THE EFFECTIVENESS OF COORDINATED INTERVENTIONS AND NON-COORDINATED INTERVENTIONS IN THE DOLLAR-DM EXCHANGE MARKET

| Equation (OLS) | $S_t^u = a_0 + a_1 S_t^p + a_2 S_{t-1}^u + a_3 \Delta(i^{DM}-i^{\$})_t + a_4 CINV_t + a_5 NCINV_t^{DBB} + a_6 NCINV_t^{FED}$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | $a_0$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $a_6$ | $R^2$ | $\bar{R}^2$ | DW | LM |
| Febr.-June 1985 | -0,0183 (-0,265) | 0,8926 * (8,695) | 0,1139 (1,111) | -3,4800 (-1,188) | 0,0219* (3,268) | -0,0068 (-0,665) | — | 0,9625 | 0,9605 | 2,1083 | 0,5315 |
| July-Dec. 1985 | See table 1, no interventions by the FED-reserve | | | | | | | | | | |
| Jan.-June 1986 | See table 1, idem | | | | | | | | | | |
| July-Dec. 1986 | See table 1, idem | | | | | | | | | | |
| Jan.-June 1987 | 0,1656* (3,763) | 0,9445 * (11,582) | -0,0352 (-0,424) | 1,7800* (2,264) | 0,0066 (0,516) | -0,0022 (-0,218) | 0,0077 (0,500) | 0,9320 | 0,9283 | 1,7791 | 1,2570 |
| July-Dec. 1987 | 0,0260* (1,997) | 1,0293 * (14,540) | -0,0440 (-0,614) | 0,6698* (2,376) | -0,0081 * (-2,851) | -0,0012 (-1,267) | 0,0016 (0,577) | 0,9952 | 0,9950 | 2,2411 | 1,9765 |
| Jan.-June 1988 | 0,0550 (1,353) | 0,8437 * (7,565) | 0,1246 (1,064) | 0,3212 (0,401) | 0,0023* (2,754) | -0,0032 * (-2,817) | -0,0044 (-0,188) | 0,9604 | 0,9584 | 1,8466 | 0,1807 |
| July-Aug. 1988 | 0,2939* (2,877) | 1,1341 * (6,406) | -0,2904 (-1,564) | -0,4982 (-0,332) | 0,0026 (0,877) | 0,0083 (0,797) | -0,0013 (-0,093) | 0,9026 | 0,8864 | 2,3616 | 2,2340 |

See note table 1, t-values within brackets
* = statistically significant at a 5%-level

larger than expected, the announcement will result in an appreciation respectively a depreciation of the dollar[28].

Table 2 presents the estimates for the modified regression equation (6), including the effects of the monthly announcements of the U.S. trade balance. Two conclusions can be drawn from this table. Firstly, the news on the U.S. trade balance had more often a significant impact on the exchange rate in the last two years, as the attention of the market participants focused on the worldwide balance of payments disequilibria. Secondly, the interventions by the Federal Reserve turn out to have had a significant influence on the exchange rate in the first half of 1988 and the intervention coefficient of the Bundesbank ($a_4$), although not statistically significant changes from a negative sign (in table 1) to an expected positive sign in both subperiods of 1988. A closer inspection of the data reveals that dollarpurchases by both central banks after disappointing news on the U.S. trade deficit in April 1988 were not effective, that is, the dollar dropped with 1,6 per cent in Frankfurt the day of the announcement. The reverse case held in June and July of 1988; dollarsales of the Bundesbank and the Federal Reserve were accompanied by a rise in the value of the dollar as a result of the announcement of a smaller than expected U.S. trade deficit. This result may suggest that interventions are less effective in countering sharp exchange rate movements after announcements of economic indicators, which are important determinants for the market expectations[29].

Table 3 comprises the estimates for the regression equation (4), where a distinction was made between coordinated and non-coordinated intervention. The results give some support to the hypothesis that coordinated interventions are more effective in influencing the exchange rate. In all periods under review non-coordinated intervention by either the Bundesbank or the Federal Reserve did not have an immediate significant positive

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28) The news-content of the U.S. trade deficit announcements in the period February 1985-August 1988 is summarized in the Appendix.

29) Such a conclusion is however hard to prove, because of the methodological issue that the ex-post exchange rate change includes the effect of interventions. Without the interventions the exchange rate change might have been larger as a result of the announcement.

TABLE 4. THE ANNOUNCEMENT EFFECTS OF OFFICIAL INTERVENTIONS IN THE DOLLAR-DM EXCHANGE MARKET

| Equation (OLS) | $S_t^u = a_0 + a_1 S_t^p + a_2 S_{t-1}^u + a_3 \Delta(i^{DM} - i^{\$})_t + a_4 IINV_t^{DBB} + a_5 SINV_t^{DBB} + a_6 INVV_t^{FED} + a_7 SINV_t^{FED}$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | $a_0$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $a_5$ | $a_6$ | $a_7$ | $R^2$ | $\bar{R}^2$ | DW | LM |
| Febr.-June 1985 | -0,0123 (-0,190) | 0,8481 * (8,732) | 0,1560 (1,611) | -3,1142 (-1,140) | 0,0424* (4,736) | -0,0074 (-0,805) | -0,0491 (-0,697) | -0,0101 (-0,124) | 0,9678 | 0,9653 | 2,0174 | 0,0337 |
| July-Dec. 1985 | 0,0252 (1,002) | 1,0995 * (13,460) | -0,1090 (-1,339) | -1,1886 (-0,841) | 0,0793 (1,402) | -0,0004 (-0,021) | — | — | 0,9902 | 0,9898 | 2,1439 | 0,6888 |
| Jan.-June 1986 | See table 1, the Deutsche Bundesbank intervenes just once the Federal Reserve does not intervene in this period | | | | | | | | | | | |
| July-Dec. 1986 | -0,0028 (-0,100) | 0,9739 * (11,755) | 0,0268 (0,330) | 0,0779 (0,123) | 0,2994* (2,529) | 0,0017 (0,297) | — | — | 0,9789 | 0,9780 | 1,7843 | 1,4145 |
| Jan.-June 1987 | 0,2318* (3,708) | 1,0099 * (13,322) | -0,1331 * (-1,700) | 0,2658 (1,447) | -0,0075 (-0,518) | -0,0040 (-0,273) | 0,0153 (0,656) | — | 0,9302 | 0,9265 | 1,7621 | 1,6486 |
| July-Dec. 1987 | 0,0292* (2,285) | 1,0400 * (14,394) | -0,0565 (-0,774) | 0,6338* (2,211) | -0,0138 (-1,211) | -0,0052 (-0,682) | -0,0170 (-1,201) | -0,0087 (-1,535) | 0,9952 | 0,9950 | 2,2154 | 1,5691 |
| Jan.-June 1988 | 0,0373 (0,838) | 0,8591 * (7,816) | 0,1199 (1,019) | 0,4361 (0,564) | -0,1088 * (-3,836) | -0,0040 (-0,393) | 0,0145 (0,7000) | 0,0168 (1,229) | 0,9626 | 0,9603 | 1,8340 | 0,1935 |
| July-Aug. 1988 | 0,2273* (2,169) | 1,1355 * (6,078) | -0,257 (-1,351) | -0,898 (-0,648) | -0,0441 (-1,136) | -0,0018 (-0,305) | 0,0217 (1,358) | 0,0047 (0,686) | 0,9102 | 0,8923 | 2,0326 | 0,0781 |

Note: See Table 1. t-values within brackets
* = statistically significant at a 5%-level

impact on the exchange rate. In contrast, coordinated interventions influenced the exchange rate immediately, as expected, in the first half of 1985 and 1988.

Although the volume of intervention by the Bundesbank exceeded the volume of intervention by the Federal Reserve more than five times in February and March 1985, a comparison between the coordination coefficient ($a_4$) and the non-coordination coefficient of the Bundesbank ($a_5$) suggests that above all the coordinated interventions with the Federal Reserve were effective in changing the rise of the dollar in the last week of February into a decline[30]. The same conclusion can be drawn for the coordinated dollar purchases of both central banks in January 1988, which provided a clear signal to the market that the monetary authorities were committed to the G7 statement of 22 December 1987 (the so-called Telephone-Accord), that a further decline of the dollar could be counterproductive by damaging growth prospects in the world economy[31]. On the contrary, the significant negative coordination coefficient ($a_4$) in the second half of 1987 presents a rather counter intuitive result; although the Bundesbank and the Federal Reserve coordinated interventions frequently, they were apparently not able to counter the dollar's decline after the stock market crash in October 1987 up to December 1987.

Finally, Table 4 presents the estimates for regression equation (5) with the distinction between initial and subsequent interventions by the Bundesbank and the Federal Reserve.

The results indicate the existence of an important announcement effect of initial interventions by the Bundesbank in the first half of 1985 and the second half of 1986. Besides, there is some evidence for effective initial interventions by the Bundesbank in the second half of 1985 and by the Federal Reserve in July and August 1988. The unexpected negative sign of the initial coefficient ($a_4$) for the Bundesbank in the first half of 1988

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30) In this respect the positive and significant intervention coefficient for the Bundesbank and the negative but insignificant intervention coefficient for the Federal Reserve during the first half of 1985 on Table 1 may lead to wrong conclusions.

31) See Cross (Winter 1987-'88), p. 57.

is due to an intervention after disappointing news on the U.S. trade deficit in April 1988. This suggests that even the announcement effect of an initial intervention does not outweigh news on more fundamental economic developments for the market. The estimates provide no evidence for a difference in effectiveness between initial and subsequent interventions by the Federal Reserve. This result may be explained by the fact that the Federal Reserve intervenes in all subperiods less than the Bundesbank. As the Federal Reserve does not intervene frequently, the difference in the announcement effect between initial and subsequent intervention for the market may be small.

## 4. CONCLUSION

Officially, the Deutsche Bundesbank and the Federal Reserve System intervene in the foreign exchange market actively to counter disorderly market conditions. In the period between February 1985 up to August 1988 daily interventions may, however, have served other purposes, for instance lowering the dollar after the Plaza Summit and stabilizing the dollar after the Louvre Summit. Whatever their precise objective, exchange market interventions can affect the exchange rate through the expectations channel in theory. If an intervention provides the market with new information or a signal about the future course of the exchange rate or of monetary policy and if the market is highly efficient, the exchange rate will immediately change after the intervention.

Our empirical analysis, on the contrary, suggests that in practice the effectiveness of exchange market intervention is limited in the sense that much depends on the specific circumstances under which the monetary authorities intervene. Our results suggest that interventions to counter market pressures, which resulted through changes in market expectations based on 'fundamentals', were not effective. However, this conclusion has to be handled carefully, because of the unsettled methodological problem that the exchange rate movements might have been more pronounced without the interventions.

Part of the ineffectiveness of interventions may reflect the difficulty for the Bundesbank and the Federal Reserve to counter sharp exchange rate

changes following important news for the market, such as the monthly announcements of the U.S. trade balance figure. The effect of unexpected changes in these economic indicators on the market expectations apparently exceeds the effect of news on interventions by both central banks.

Nevertheless, intervention can have an important effect on the exchange rate, especially when the Bundesbank and the Federal Reserve undertake a concerted action. Our results indicate that coordinated interventions were more effective than non-coordinated interventions. Thus, it appears that the market interprets a coordinated intervention as an important signal that both monetary authorities are determined to change the exchange rate.

Finally, interventions may have an important announcement effect after a period of no intervention. According to our results initial interventions by the Bundesbank were more effective than subsequent interventions. In order to attain an important announcement effect, a selective intervention strategy and a careful timing of the interventions therefore seems to be very important.

APPENDIX: DATA DESCRIPTION

The opening and closing exchange rates are rates in Frankfurt and were taken from the Statistische Beihefte zu den Monatsberichten der Deutschen Bundesbank, Reihe 5, Tabelle 6: Kassakurse des US-dollar in Tagesverlauf. The opening and closing rates are published from February 1985. The rates are the DM price of one dollar. The interest rates are one month Eurodollar- and EuroDM-closing rates in London. Eurorates were preferred above domestic rates, because Eurodeposito's are close substitutes.

The daily intervention data were kindly provided by the Deutsche Bundesbank and concern active interventions in the U.S. dollar-DM market by the Bundesbank and the Federal Reserve System, expressed in billions of DM. However, interventions by the Federal Reserve were only listed as far as these interventions resulted in a change of the net foreign currency reserves of the Bundesbank. The data were available until September 1988.

The dummy-variables for the announcement-effect of the monthly publication of the U.S. trade balance figure have been constructed carefully using the Dutch financial newspaper 'Het Financieele Dagblad'. The following table indicates the news-content of the announcements and thus their expected effect on the excange rate:

| m / y | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985[1)] | - | - | - | - | - | - | - | + | + | - | - | - |
| 1986 | - | + | - | - | - | - | - | - | + | + | + | - |
| 1987 | + | - | NA[2)] | - | o | + | - | - | - | - | + | - |
| 1988 | + | + | + | - | + | + | + | - | | | | |

Note: The U.S. trade deficit figure was smaller-than-expected (+) or larger-than-expected (-) or as expected (o).

1) In 1985 the pattern of U.S. trade deficit announcements differs somewhat from the more regular monthly pattern in the other periods.
2) In March 1987 there was no announcement as the U.S. Commerce Department decided to release the monthly reports about two weeks later, half April.

A comparison of this table and Table 2 leads to the conclusion that whenever the U.S. trade balance-figure announcement had a significant impact on the exchange rate, the sign corresponds to the expected sign in this table.

REFERENCES

Argy, V., The Postwar International Money Crisis - An Analysis, London, George Allen & Unwin, 1981.

Cross, S.Y., 'Treasury and Federal Reserve Foreign Exchange Operations - Report to the Congress', Quarterly Review, Federal Reserve Bank of New York, various issues.

Eijffinger, S.C.W., 'The relative positions of the currencies within the EMS band of fluctuation: an empirical study', in International Monetary and Financial Integration - The European Dimension, edited by Fair, D.E. & de Boissieu, C., Dordrecht, Martinus Nijhoff, 1988.

Eijffinger, S.C.W. & Gruijters, A.P.D., 'On the short term objectives of daily interventions by the Deutsche Bundesbank and the Federal Reserve System in the U.S. dollar/DM exchange market', forthcoming 1989.

Funabashi, Y., Managing the dollar: From the Plaza to the Louvre, Institute for International Economics, Washington, DC, 1988.

Genberg, H., 'Effects of Central Bank Intervention in the Foreign Exchange Market', IMF Staff Papers, Vol. 28, no. 3, 1981, p. 451-476.

Gleske, L., 'Die Devisenpolitik der Deutschen Bundesbank, Interventionen am DM-$-Markt und im Europäischen Währungssytem sowie geldmarktorientierte Devisentransaktionen', Kredit und Kapital, vol. 15, 1982, p. 259-274.

Humpage, O.F., 'Exchange market intervention: The Channels of Influence', Economic Review, Federal Reserve Bank of Cleveland, 1986, no. 3, p. 2-13.

Humpage, O.F., 'Intervention and the Dollar's Decline', Economic Review, Federal Reserve Bank of Cleveland, 1988, no. 2, p. 2-16.

Lehment, H., Devisenmarktinterventionen bei flexiblen Wechselkursen, Die Politik des Managed Floating, Kieler Studien 162, J.C.B. Mohr (P. Siebeck), Tübingen, 1980.

Loopeskoo, B., 'Relationships among Exchange Rates, Intervention and Interest Rates: An Empirical Investigation', Journal of International Money and Finance, 1984, no. 3, p. 257-277.

Mayer, H. & Taguchi, H., 'Official intervention in the exchange markets: Stabilising or destabilising?', BIS Economic Papers, no. 6, March 1983.

Müller, B., 'Der Jurgensen-Bericht: Eine Stellungnahme', in Devisenmarktinterventionen der Zentralbanken, edited by Ehrlicher, W. & Richter, R., Schriften des Vereins für Socialpolitik, no. 139, Berlin, 1984.

Ohr, R., 'Notenbankinterventionen und Effizienz der Devisenmärkte', Überlegungen zur Dollarkursentwicklung', Kredit und Kapital, vol. 20, 1987, no. 2, p. 200-214.

Rieke, W., 'Die Rolle von Interventionen als Bestimmungsfaktor der Wechselkurse beim "Floating": Ergebnisse des von einer internationalen Arbeitsgruppe erstellten Erfahrungsberichts', in Devisenmarktinterventionen der Zentralbanken, edited by Ehrlicher, W. & Richter, R., Schriften des Vereins für Socialpolitik, no. 139, Berlin, 1984.

Rogoff, K., 'On the effects of sterilized intervention', Journal of Monetary Economics, vol. 14, 1984, p. 133-150.

Schlesinger, H., 'Stellungnahme zum Thema "Sterilisation"', in Devisenmarktinterventionen der Zentralbanken, edited by Ehrlicher, W. & Richter, R., Schriften des Vereins für Socialpolitik, no. 139, Berlin, 1984.

Scholl, F., 'Implications of Monetary Targeting for Exchange-Rate Policy', in Central Bank Views on Monetary Targeting, edited by Meek, P., Federal Reserve Bank of New York, 1983.

Sijben, J.J., 'External disequilibria and the burden of economic adjustment in the world economy, in Financing the world economy in the nineties, edited by Sijben, J.J., Tilburg Institute of Advanced Studies, Kluwer Academic Publishers, Dordrecht, 1989.

Working Group on Exchange Market Intervention, (Chairman: Philippe Jurgensen), Report, March 1983.

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